Key

Centre

for

Statistical

Science

Postgraduate Coursework Programme

Draft of Student Booklet for 2012,
29 February 2012 version.

Semester 1 starting dates:

La Trobe, Monash & RMIT Universities - 27 Feb

Semester 2 starting dates:

La Trobe & Monash Universities - 23 July

RMIT University - 16 July

Department	KCSS coordinator	Contact details
Department of Mathematics and Statistics La Trobe University	Assoc. Prof. Paul Kabaila (Director)	Phone: 9479 2594 Fax: 9479 2466 P.Kabaila@latrobe.edu.au
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Melbourne University units

Subject to an agreement between the lecturers and the student, it may be possible for a student from La Trobe, Monash or RMIT to take components from Melbourne University. For any queries, please contact Prof. Kostya Borovkov on K.Borovkov@ms.unimelb.edu.au

Please visit the following official KCSS web site for an on-line version of this handbook, late changes to unit details and important notices:

http://www.latrobe.edu.au/mathstats/kcss/index.html

Contents

1 Key Centre for Statistical Science courses

The Key Centre for Statistical Science (KCSS) links statisticians and econometricians from La Trobe University, Monash University and RMIT University.

The main function of the KCSS is to offer courses leading to a BSc (hons), BCom(Hons), or a masters degree. Students must apply for admission at one of the participating universities. They should first discuss their proposed course with the course coordinator of the department, and complete the university's application form for admission to candidature.

For honours students, enrolments will need to be completed at the required time for that university. Applicants may enrol either on a full-time or a part-time basis. Depending on the course components chosen, candidates may be required to attend lectures at more than one university.

1.1 Master of Statistical Science (SMST): La Trobe

Description: The course aims to provide opportunities for students to further their understanding of the statistical modelling of physical, biological and economic phenomena so they can contribute to applied research and development in industry, commerce and research.

Entry requirements: Entry to the La Trobe Master of Statistical Science program can be with a standard 3-year bachelor degree with a major in statistics (with sufficiently high marks), but is normally with an Honours degree in statistics, or equivalent.

Students who have already completed an Honours year in statistics (at a level deemed appropriate for entry into the Masters program and which is further accepted as being equivalent to the La Trobe University standard for an Honours year in statistics) complete a one year full-time (or two years part-time) course consisting of:

1. Four approved elective components*
2. Supervised consulting experience
3. Minor thesis.

Students who are accepted into the program with a standard 3-year bachelor degree that consists of a major in statistics complete a two year full-time (or up to 4 years part-time) course. For these students the first year of the program either:

a. Is equivalent to a La Trobe University Honours year in statistics consisting of 5 approved elective components and a minor thesis; or

b. Consists of 8 approved elective components* (Note: this option is available on the proviso that a sufficient number of appropriate subjects are available that would allow the student to successfully satisfy the requirements for completion of the program).

The second year of the program for these students then consists of:

1. Four approved elective components*
2. Supervised consulting experience
3. Minor thesis.

*Elective components are usually chosen from a wide variety of possibilities that include:

- La Trobe University honours level statistic subjects
- KCSS elective components
- Appropriate Access Grid Room (AGR) subject offerings (for further information see http://www.amsi.org.au/research-a-higher-education/access-grid/agabout)
- Appropriate AMSI Summer School subjects (for further information see http://www.amsi.org.au/research-a-higher-education/higher-education/summer-school)
- Approved La Trobe University honours/masters level subjects from non-statistics disciplines which are deemed to have appropriate statistics content or that adequately complement the Masters program (examples include certain mathematics, finance, econometrics and computer science subjects).

AMSI Industry Internship Program: Sufficiently high achieving students entering the final year of the Masters program may have the possibility to take part in the AMSI Industry Internship Program. Such an opportunity would usually be undertaken in the student's final semester. Subject to the availability of supervision, suitable projects may be conveniently aligned with the minor thesis and the consulting experience. The internship is usually conducted over 4-5 months and successful applicants receive payment of up to $3,000 per month. For more information and information regarding suitable contacts see http://www.amsi.org.au/industry/amsi-intern/overview.

1.2 Master of Applied Econometrics (M.App.Econometrics): Monash University

Description: This course provides the quantitative skills and expertise required to carry out regression analysis, forecasting and financial market analysis. Students acquire the skills to take responsibility for designing and implementing applied econometric projects and the ability to communicate the results to wider audiences. These skills are extremely attractive to the business and finance community.

Objectives: Master of Applied Econometrics aims to produce graduates who will

a) be critical and creative scholars who produce innovative solutions to problems, apply research skills to business challenges and communicate effectively and perceptively;

b) be responsible and effective global citizens who engage in an internationalised world, exhibit cross cultural competence and demonstrate ethical values;

c) have a comprehensive understanding of econometric methods and be able to provide discipline based solutions relevant to the business, professional and public policy communities we serve; and

d) have advanced knowledge to masters level in applied econometrics.

Structure: The course structure comprises both a major specialisation in econometrics and business statistics and a research project.

Requirements: Students must complete:

a) two core research units (18 points), including the 12 point research project unit;

b) six foundational units (36 points) taken from an approved list of units, including at least one of either ETF5200 Applied econometrics or ETF5400 Special topics in econometrics;

c) a further three units (18 points) subject to course coordinator approval, which may be taken from disciplines offered by another Monash faculty or from any Monash Faculty of Business and Economics program or campus.

A minimum of eight units (48 points) must be completed at 4000 or 5000-level.

Research component: The course has a mandatory research component comprising either 16 per cent or 33 per cent of the total course, depending on the option selected.

Progression to further studies: This degree may serve as a pathway to a higher degree by research. Students considering a research degree are advised to consult the course coordinator prior to making an application.

Alternative exit(s): Provided the appropriate requirements are satisfied, students wishing to exit the Master of Applied Econometrics early may apply to graduate with either a Graduate Certificate in Business (after successful completion of 24 points of study) or a Graduate Diploma in Applied Econometrics (after successful completion of 48 points of study).

For more details about this course, please refer to the Monash University - Postgraduate Handbook at http://www.monash.edu.au/pubs/2011handbooks/courses/3822.html.

1.3 Master of Statistics and Operations Research (MC004): RMIT

The statistics and operations research programs are designed for students who want to further their knowledge of statistical methodology. They provide a theoretical foundation combined with practical applications of current techniques employed by practising engineers, scientists and other professionals in industry, research, teaching and business. The master aims to provide opportunities for you to further your understanding in the modelling of physical, biological and economic phenomena, ensuring you are able to contribute to applied research and development in industry and commerce.

Program Structure

This master consists of 16 Statistics & OR subjects. It has 3 core subjects and two consulting practice subjects, and 11 electives. This incorporates graduate diploma consisting of 8 subjects and graduate certificate consisting of 4 subjects.

Entrance requirements

A bachelor degree or diploma of at least three years' study (post-Year 12) with a credit in a first year mathematics course or equivalent.

1.4 Master of Analytics (MC122): RMIT

This program will enable you to develop a good working knowledge of analytics and become equipped with skills in the use of software tools that can be readily applied in this rapidly changing environment. You will learn to model economic and industrial phenomena, and will also become familiar with methods for the acquisition and analysis of data using contemporary analytics software and computer related technologies. With an increase in finance and related disciplines needing skills in analytics, specifically in the areas of data analysis, financial modelling and forecasting, there is a gap in employees' experience and currently this is bridged by on-the-job training within organisations or by calling in consultants to complete specialist work. This gap exists across the spectrum of business disciplines. This master puts analytics into a business context and allows you to apply statistical concepts to the business world.

Program Structure

The Master of Analytics consists of a mixture of 12 Statistics & OR and Business subjects. It has 3 core subjects and two consulting practice subjects, and 7 electives. This incorporates graduate diploma consisting of 8 subjects and graduate certificate consisting of 4 subjects.

Entrance requirements

An equivalent Australian undergraduate degree in any discipline with a minimum of 65% achieved in a mathematics course/subject or equivalent.

1.5 Honours Year: La Trobe, Monash and RMIT

The Key Centre elective subjects may be taken by students completing an honours degree as part of their coursework. Students should consult their home institution for details about other components of their honours year.

1.6 Generic skills

In addition to learning specific technical skills that will assist you in your future careers in science, engineering, commerce, education or elsewhere, you will have the opportunity to develop in this program, generic skills that will assist you whatever your future career path.

- You will develop problem-solving skills including engaging with unfamiliar problems, and identifying relevant strategies.
- You will develop analytical skills - the ability to construct and express logical arguments and to work in abstract or general terms to increase the clarity and efficiency of the analysis.
- Through interactions with fellow students, you will develop the ability to work in a team. The department distinguishes between ethical collaboration, which is strongly encouraged, and plagiarism, which is prohibited.
- You will develop your oral presentation skills, practicing presentation of technical solutions. This practice will assist you in learning how to present material in a well-organized, well-structured, lucid and persuasive fashion.
- With assessable material to be submitted throughout the semester, you will learn to manage your time, balance competing commitments and set and meet regular deadlines.

2 Components and timetable

Several components require some background in statistical computing packages. Students should ensure that they have familiarity with the computing facilities at their home institution and have an adequate background in the computing required in the components of their choice. The weeks for lectures in each KCSS component are determined by the semester dates for the institution offering that component.

2.1 Lecture timetable

IMPORTANT: Please check the official KCSS web site for late changes and other up to date information/notices. This timetable may change before, or after, classes start. For more information about the timetable for the electives, please contact the lecturer or the KCSS Coordinator of your home institution. The KCSS Coordinator's name and contact details for each institution are given on the page after the title-page.

FIRST SEMESTER				
Component	**Lecturer**	**Day**	**Time**	**Location**
RA	Prendergast	Tuesday	9am–11am	La Trobe, PS2, room 233 (R.A. Fisher lab)
AMD	Chan	Tuesday	12noon–2pm	La Trobe, PS2 310 (Access Grid Room)
SC	Klebaner	Thursday	1pm–3pm	Monash, Clayton, M442
STP I	Miller	Thursday	10am–12noon	Monash, Clayton, M442
TSA	Stacey	Wednesday	5.30pm–7.30pm	RMIT,Building 13,Level 1,Room 3

SECOND SEMESTER				
Component	**Lecturer**	**Day**	**Time**	**Location**
SI	Kabaila	Tuesday	12noon–2pm, extra help at 2	La Trobe, PS2 310 (Access Grid Room)
SA	Olenko	Tuesday	9am–11am	La Trobe, PS2 233
PEC	Harris	Mon	12–2pm	Bldg 32, rm E4, Monash
		Either Tues	2pm–4pm	Bldg 11, rm E163, Monash
		or Thur	9am–11am	Bldg 11, rm E163 Monash
		or Thur	3pm–5pm	Bldg 11, rm E163, Monash
FE 2	Anderson/Forbes	Wed	9.30am–11am	Bldg 6, rm G19, Monash
		Wed	2pm–3.30pm	Bldg 6, rm G34, Monash
BEA	Martin/Forbes	Mon	10am–11.30am	Building 5, room KG24, Monash
		Thur	11am–12.30pm	Building 5, room KG24, Monash
IB	Keith/Tian			Monash
OPT	Smith-Miles/			Monash
	Miller			Monash
STP II	Markowsky/			Monash, Clayton

3 Elective components

The following list of components contains a brief summary of syllabus, references and prerequisite knowledge that will be assumed in each of the components. Students should use this information to choose suitable components and to revise their knowledge in preparation for attending those components.

The KCSS grades results in elective components as follows:

Grade	Description	Percentage Mark		
A	very good to excellent	75	to	100
B	satisfactory	65	to	74
C	unsatisfactory	50	to	64
D	poor	0	to	49

Further information concerning the lecturer, the semester in which the component is to be offered and the venue are also given for each component in the list. Refer to Section 2.1 (Lecture Timetable) for information on lecture times and room numbers.

AMD | Analysis of Medical Data

Lecturer Dr Siew-Pang Chan, La Trobe.

Syllabus

This subject covers the following topics: measures of disease frequenc, analysis of case-control data, regression for case-control studies, matching for case-control studies, sample size determination for case-control studies, cohort studies, regression for cohort studies and diagnostic testing.

Prerequisites

1 Inference: basic concepts of estimation, confidence intervals and hypothesis testing; maximum likelihood.

2 Some introduction to programming using a statistical computing package (for example, R).

References

Altman, D.G. (1991) *Practical Statistics for Medical Research*, Chapman and Hall, London.

Breslow, N.E. and Day, N.E. (1980) *Statistical Methods in Cancer Research, Vol.1, The Analysis of Case Control Studies*, Lyon: IARC Scientific Publication No.32.

Clayton, D. and Hills, M. (1993) *Statistical Methods in Epidemiology*, Oxford Science Publications.

Pocock, S.J. (1983) *Clinical Trials*, Wiley, Chichester.

Schlesselman, J.J. (1982) *Case Contorl Studies*, Oxford University Press.

BEA Bayesian Econometric Analysis (Monash)

Lecturers Professor Gael Martin and A/Prof Catherine Forbes, Monash.

Syllabus

This unit covers the use of Bayesian methods in econometrics, with a particular emphasis on time series applications. In addition to providing an overview of the Bayesian paradigm and its relationship to frequentist (or classical) inference, the unit focuses on computational methods, including Markov chain Monte Carlo and related methods, as well as filtering and smoothing methods for non-Gaussian state space models.

Objectives

The learning goals associated with this unit are to:

- examine methodological developments at the forefront of Bayesian econometric analysis;
- explain the relevance and importance of Bayesian methods for time series analysis;
- provide an understanding of modern Bayesian numerical analysis, with particular emphasis given to Markov chain Monte Carlo methods

Assessment

Within semester assessment: 40%, Examination: 60%.

Contact Hours

Two 1.5 hour lectures per week.

Prerequisites

Students should have passed the equivalent of one of Monash University units ETC4400, ETC4410, ETC4420 before undertaking this unit.

FE2 | Financial Econometrics 2

Lecturers: Professor Heather Anderson and Dr. Catherine Forbes

Offered in the second semester at the Clayton Campus.

Syllabus

This unit introduces students to a range of advanced, current techniques used in analysing financial data. Topics covered include the analysis of the time series and distributional features of financial data; the use of stochastic volatility and realised volatility models to capture time-varying volatility, including long memory in volatility; the use of econometric methods to estimate Value at Risk; the modelling of transactions data using trade duration models and transaction-based volatility models; continuous time processes and the application of econometric techniques to option pricing; and the use of generalised method of moments in financial models.

Objectives

The learning goals associated with this unit are to:

- critically evaluate alternative methods of modelling asset return volatility
- explain the role of volatility modelling in the measurement of risk and in the pricing of financial derivatives
- describe the role of continuous time stochastic processes in the pricing of financial derivatives
- evaluate econometric models for high frequency data
- evaluate the use of generalized method of moments in financial models

Assessment

Within semester assessment: 40%; Examination (3 hours): 60%.

Contact Hours

Two 1.5 hour lectures per week.

Prerequisites

Students must have passed the equivalent of one of Monash University units ETC3460 or ETC4346 and at least one of: ECC3410, ETC3400, ETC3410, ETC3450, before undertaking this unit.

IB Introduction to Bioinformatics

Lecturers Dr Jonathan Keith, Dr Tianhai Tian

Contact Details:

Jonathan.keith@monash.edu, Room 451, Building 28, Tel.: 9902 0890. Tianhai.Tian@monash.edu, Room 454, Building 28, Tel.: 9905 4474.

Aims

Bioinformatics is a broad term for the use of computers in solving information problems in the life sciences. As such it brings together a range of concepts and techniques from mathematics, statistics and computer science and applies them to the analysis of biological data, usually at the molecular level. This unit aims to provide the student with a broad awareness of the field from three perspectives: data, methodology and application.

Syllabus

1. Sequence Alignment and Analysis 2. Phylogenetics and Comparative Genomics 3. Structure Prediction 4. Functional Genomics 5. Systems Modelling, Inference and Simulation

Prerequisites

MTH2010; MTH2051 or MTH3051 would be helpful, as would STA2032.

Recommended Reading

Mount, D. W. (2004) *Sequence and Genome Analysis, 2nd Edition*, CSHL Press.

References

Pevsner, J. (2003) *Bioinformatics and Functional Genomics*, John Wiley.

Parida, L. (2008) *Pattern Discovery in Bioinformatics*, Chapman & Hall.

OPT | Optimization (Applied Statistics)

Lecturers Professor Kate Smith-Miles and Dr Boris Miller

Contact Details:

Kate.Smith-Miles@sci.monash.edu.au , Room 441, Building 28, Tel.: 9905 3170.
Boris.Miller@sci.monash.edu, Room 464, Building 28, Tel.: 9905 5870.

Aims

This unit is a 4 point honours lecture topic. The aim of this topic is to introduce students to the techniques for solving optimization problems of various kinds: continuous, combinatorial, unconstrained and constrained, deterministic, stochastic, and optimal control problems. Students then study in more detail the application of the Dynamic Programming method for optimization of discrete and continuous systems.

Syllabus

To be advised.

Prerequisites

Linear algebra, calculus, probability theory.

Contact Hours

Two lectures per week.

References

BERTSEKAS, D. (2005) *Dynamic Programming and Optimal Control*, Athena Scientific.

PEC | Principles of Econometrics

Lecturer Professor David Harris, Monash University.

Syllabus

This unit provides a formal treatment of the core principles underlying econometric and statistical analysis, with particular focus given to likelihood-based inference. Topics covered include the likelihood principle and maximum likelihood estimation; minimum variance unbiased estimation; maximum likelihood asymptotic distribution theory; likelihood-based hypothesis testing; and quasi-maximum likelihood inference. The theoretical developments are supplemented by numerical results produced using computer simulation. Consideration is also given to the numerical optimisation techniques used to implement likelihood-based procedures in practice.

Objectives

The learning goals of this unit are to:

- consolidate the core principles underlying econometric and statistical analysis;
- understand and implement the technique of maximum likelihood estimation and develop an appreciation of the associated asymptotic distribution theory;
- understand and implement likelihood-based hypothesis testing and quasi-maximum likelihood inference;
- develop the skills needed to demonstrate and explore theoretical sampling properties using computer simulation;

Assessment

Within semester assessment: 40%. Examamination (2 hours): 60%.

Contact Hours

Two 1-hour lectures and one 2-hour tutorial per week.

Prerequisites

Students must have passed the equivalent of one of Monash University units ETC2400, ECC2410, ETC2410 or ETC3440 before undertaking this unit.

RA Regression Analysis

Lecturer Dr Luke Prendergast.

Syllabus

Multiple linear regression; classical estimation and testing; residual analysis; practical experience using the statistical package R; diagnostics; weighted least squares; ridge regression; robust regression; an introduction to modern dimension reduction techniques including Sliced Inverse Regression.

Prerequisites Least squares fitting of multiple linear regression models. Exposure to t and F tests for ordinary least squares and familiarity with statistical inference concepts at a 3rd year level. At least an intermediate knowledge of linear algebra concepts including matrix addition and multiplication, matrix inversion, span, basis of a vector space, orthogonal vectors, eigenvalues and eigenvectors. A suitable level would be Ayres, Theory and problems of matrices Schaum's Outline Series, although not all that book need be known. Familiarity with the software package R would be useful but not essential.

References

1. Montgomery, D.C. and Peck, E.A. (2006) Introduction to Linear Regression Analysis, 4th edition, Wiley.

2. Staudte, R. and Sheather, S.J. (1990) Robust Estimating and Testing, Wiley.

SA | Spatial Analysis

Lecturer Dr Andriy Olenko, La Trobe University

Syllabus

The unit surveys the theory of random fields, spatial statistics models, and their applications to a wide range of areas, including image analysis and GIS (geographic information system). The course will cover the methodology and modern developments for spatial-temporal modelling, estimation and prediction, and spectral analysis of spatial processes. All the methods presented will be introduced in the context of specific real datasets with GRASS and R software.

Prerequisites

Basic knowledge of calculus, probability theory, and statistical inference at the third year level. Familiarity with the software package R would be useful but not essential.

Recommended prior studies for La Trobe students

STA3SI, STA2RSP

SC | Stochastic Calculus and Mathematical Finance

Lecturer Professor F.C. Klebaner, Dr Greg Markowsky, Monash.

Contact Details:
Fima.Klebaner@monash.edu, Room 460, Building 28, Tel.: 9905 4409.
Greg.Markowsky@monash.edu, Room 453, Building 28, Tel.: 9905 4487

Aims

This unit is a 6 point honours lecture topic and provides an introduction to Stochastic Calculus and mathematics of financial derivatives. Stochastic calculus is an extension of calculus to non-differentiable functions. It is a branch of pure mathematics, which found use in applications. Besides finance it is also used in engineering. We teach from the book: Klebaner, Fima Introduction to stochastic calculus with applications, 2nd Ed, Imperial College Press, 2005.

Syllabus

Variations and Quadratic variation of functions. Review of Integration and Probability. Brownian motion. Ito integrals and Ito's formula. Stochastic Differential Equations and Diffusions. Calculation of expectations and PDEs, Feynman-Kac formula. Martingales and Semimartingales. Change of Probability Measure and Girsanov Theorem. Fundamental Theorems of Asset Pricing. Change of Numeraire. Application to options.

Contact Hours

One two-hour lecture followed by a one-hour tutorial, per week.

Prerequisites:

Some knowledge of probability is required and some knowledge of financial mathematics is desirable.

References

Hull, J. () *Options, Futures and other Derivative Securities*, Prentice Hall.

Klebaner, F.C. (2005) *Introduction to Stochastic Calculus with Applications, Second Edition*, Imperial College Press.

SI | Statistical Inference

Lecturer Associate Professor Paul Kabaila, La Trobe University.

Syllabus

This component covers a selection of topics in statistical inference at the fourth year level. It consists of a selection of material from the following chapters of Casella and Berger (2002): Chapter 6 (Principles of Data Reduction), Chapter 7 (Point Estimation), Chapter 8 (Hypothesis Testing), Chapter 9 (Interval Estimation) and Chapter 10 (Asymptotic Evaluations). A knowledge of this material is helpful in almost any statistical endeavour.

Students will be given 2 weeks to complete the assignments, so as to provide them with plenty of opportunity to ask for help with these assignments. As in previous years, this subject will be taught in the Access Grid Room in the Department of Mathematics and Statistics at La Trobe University.

Contact Hours

One 2 hour lecture per week for 13 weeks. An additional help session, lasting up to half an hour, will be provided in the Access Grid Room after each 2 hour lecture.

Prerequisites

A knowledge of statistical inference at the third year level.

References

Casella, G. and Berger, R.L. (2002) *Statistical Inference, 2nd edition*, Duxbury.

STP I | Stochastic Processes I - Linear Systems

Lecturer Dr Boris Miller.

Contact Details:
Boris.miller@monash.edu, Room 464, Building 28, Tel.: 9905 5870.

Aims

This unit is a 4 point honours lecture topic and provides an introduction to general theory of stochastic processes and their applications. Stochastic processes constitute a branch of applied mathematics, which found use in various areas of engineering, resource management, control, and finance. The main uses of stochastic processes are the estimation and filtering, stochastic optimization and control.

Syllabus

Basic concepts of the probability theory and stochastic processes. Theorem of Kolmogorov and examples of random processes. Linear theory of stationary random processes. Stochastic integrals. Spectral analysis of random processes in linear systems. White noise. Random Processes with orthogonal and independent increments. Non-stationary linear systems, state and observation model. Kalman filter and its applications to stochastic optimization and control.

Prerequisites

It would be useful to have MTH2222 and MTH3241 as prerequisites. Some knowledge of basic probability is desirable.

Contact Hours

Two lectures per week.

References

Cramer, H. and Leadbetter, M. (1967) *Stationary and Related Stochastic Processes*, John Wiley & Sons, NY.

Miller, B and Pankov, A (2002) *Theory of random processes*, Moscow, Nayka.

STP II | Stochastic Processes II - Random Walks & Markov Chains

Lecturers Dr Greg Markowsky and New Statistics Staff Member arriving 2012

Contact Details:
Greg.Markowsky@monash.edu, Room 453, Building 28, Tel.: 9905 4487. Contact details of new staff member to be advised

Aims

This unit is a 6 point honours lecture topic and the aim of the unit is to provide an introduction to general theory of random walks and Markov processes. The basis of the course is martingale theory, which constitutes an important part of all modern probability theory and helps to understand most of the approaches in financial mathematics and actuarial science.

Syllabus

Martingales. Definitions and examples, stopping times. Optional stopping theorem. Convergence of martingales. Applications of martingales to analysis of random walks. Definition and properties of Markov processes, Markov chains in discrete time. Markov chains in continuous time, the birth-and-death processes. Linear stochastic differential equations and Kalman-Bucy filter.

Contact Hours

Two lectures and one tutorial per week.

Prerequisites

It would be useful to have MTH2222, MTH3230 and MTH3241 as prerequisites.

References

Ross, S. (1996) *Stochastic Processes*, John Wiley, New York.

Elliott, R., Aggoun, L. and Moor, J. (1998) *Hidden Markov Models*, Springer.

TSA | Time Series Analysis

Lecturer Dr Andrew Stacey, RMIT.

Syllabus

This course aims to provide you with a working knowledge of time series and forecasting methods as applied in economics, engineering and the natural and social sciences. The emphasis is on methods and the analysis of data sets. The course will cover: Introduction to stochastic processes; Describing and modelling time series; Smoothing and tracking techniques; Seasonal decomposition; Moving average and autoregressive processes; Integrated models; Box-Jenkins methodology; A comparison of Box-Jenkins and econometric methods; Frequency domain analysis; and a selection of topics from Non-stationary time series, Regression in time series, Multivariate time series analysis and State-Space models.

Prerequisites

Basic undergraduate exposure to stochastic processes and statistical inference. A knowledge of elementary real and complex analysis.

Text

Brockwell P.J. & Davis R.A. (2002) *Introduction to Time Series and Forecasting, 2nd ed*, Springer-Verlag, New York.

References

Bloomfield, P. (1976) *Fourier Analysis of Time Series: an introduction*, John Wiley, New York.

Bowerman, B.L. & R.T. OConnell (1993) *Forecasting and Time Series: an applied approach*, Duxbury Press, Belmont Ca.

Box, G.E.P. & G.M. Jenkins (1977) *Time Series Analysis: Forecasting and Control, revised edition*, Holden-Day, San Francisco.

Chatfield, C. () *The Analysis of Time Series, an introduction*, .

Cryer, J.D. (1988) *Time Series Analysis*, Duxbury, Boston.

Fuller, W.A. (1976) *Introduction to Statistical Time Series*, John Wiley, New York.

Lütkepohl, Helmut (1991) *Introduction to Multiple Time Series Analysis*, Springer-Verlag, Berlin.

Priestley, M.B. () *Spectral Analysis of Time Series*, .

4 Minor thesis

Each coursework master's candidate is required to write a Minor Thesis under the supervision of a staff member from the candidate's home university (that is, the university where the candidate is enrolled).

In keeping with the objectives of the coursework master's program, the thesis should normally be on a topic of applied statistics. Typically, a thesis might give a critical review of some statistical analyses and illustrate their application to an original data set, possibly incorporating adjustments to the analyses which the chosen data set and the objectives of the study demand. Substantial original research is not expected, but a display of ingenuity will be highly regarded.

The abilities which should be demonstrated by a good thesis are as follows:

(a) a command of the knowledge and skills pertinent to the area;

(b) an ability to communicate in correct English and present the information in a form consistent with the scientific conventions for Statistics;

(c) an ability to survey critically the relevant literature;

(d) an ability to state objectives clearly, to pursue them methodically and to argue clearly and critically;

(e) a critical appreciation and understanding of the relationship of the candidate's own work to that of others;

(f) an ability to contribute to the knowledge of the subject.

The abilities are ranked. The further up the ranking the demonstrated abilities the better the thesis. Thus, an excellent thesis would be one showing an ability to contribute to the subject. To pass, a reasonable level of abilities (a)–(d) must be demonstrated.

Past experience shows that full-time students spent 25 to 50 percent of their study time (in the final year) working on the thesis.

There will be two examiners for each thesis, at least one of whom will be an external examiner (i.e. not from the home university). The supervisor cannot be an examiner for the thesis. If examiners return conflicting reports, a third examiner will be appointed.

Role of your supervisor

The supervisor is expected to:

- provide guidance in selecting a topic;
- give you references to books and papers etc.;
- advise on any problems encountered during the process and regularly discuss with you the progress of your research;

- point out the typing or other errors in the thesis, as far as possible leaving the corrections to be made by you;
- advise about the presentation of the thesis and final talk.

The supervisor is not expected to derive formulae or interpret the results for you.

You should keep in touch with your supervisor throughout your candidature. Fix a time to meet with your supervisor once per week or fortnight.

Research the topic

Most theses will involve the following stages of research.

LITERATURE REVIEW Almost all research is based on previous work which has been reported in the literature, and it is very important for you to be aware of relevant earlier work and to understand it. You must learn to use the libraries effectively to find the material you need. You then need to come to grips with the background of the problem you are investigating. Where does it come from? Why is it important? What is the state of the art? Are there controversies in the area? If so, how do they arise? Can they be resolved?

SUMMARIZE After this, we expect you to first *précis* the material; that is, give a summary *in your own words* of what the various researchers have written. Do not simply duplicate what other people have written. In synthesizing material from various authors, be aware that they may use different notation; your notation will need to be consistent.

APPRAISAL Then we ask you to embark on an *appraisal*; that is you judge the significance, correctness and efficiency of the papers and books you have read and summarized. Just because something has appeared in print, even in a reputable scientific journal, does not mean it is correct or useful.

When reading journal papers and research monographs, we suggest you ask yourself some basic questions.

- What is the paper about?
- What mathematical techniques are used?
- How rigorous is the discussion?
- Are controversial issues involved?
- How else might the problem have been tackled?
- Has the paper contributed insight or merely detail?

When you read a journal article you will find a list of references to other papers, judged by the author(s) to be relevant. These can be checked as additional references for you. It is often also helpful to find subsequent papers which reference the paper you are reading so that you can follow later work on that topic and find what influence it has had on other researchers. This information can be found from the *Science Citation Index* in the Reference section of the Library.

Form of the thesis

The actual form of the thesis and the type of work involved depend very much on the subject matter. Again, this requires collaboration with your supervisor. There are several common traps you should avoid.

- Do not aim to write an encyclopedia; your reading and summary of the literature should focus on the problem at hand, but should be broad enough to put these into their statistical context.
- Do not allow the project to degenerate into a massive computational exercise. You may need to do some computer programming as part of your project, but this should not be your major task.
- Keep a careful record of the references you consult so that you can construct a bibliography easily when you write up. See the bibliographies in the research papers you read for the style which is used in mathematical research.

Things that would detract from a thesis would include:

- mistakes in the mathematics or in the interpretation;
- a lack of coherent theme;
- poor presentation or proof-reading in the submitted text;
- lengthy quotations or quotations from unnamed sources;
- inconsistent notation (which suggests the student has copied the material);
- little evidence of understanding of the material, or critical appraisal of controversial matters;
- references in the main text for which details are not included in the bibliography;
- references in the bibliography which are never referenced in the main text.

When you come to write up, do so for the benefit of an intelligent reader. A good rule is to imagine a reader with your general background, but without your specific familiarity with the topic. Your report should certainly be intelligible to other Masters students. Make the writing clear and concise, but keep in mind that colloquialisms and slang are seldom acceptable in writing even if they may be acceptable in speech.

Note that explicit quotations must be acknowledged. It should be realized that the *direct* use of another author's words are often an admission that you are unable to express yourself. Such admissions lose marks if they become too frequent. Explicit quotation without acknowledgment is plagiarism and will be severely penalized.

The thesis should normally consist of approximately 60 typed A4 pages excluding tables, graphs, references, etc. A 100 page thesis is too long, and usually shows the author has failed to understand what are the key issues.

All universities require the final thesis to be properly bound but are willing to accept a thesis that is loosely bound for the purpose of examining. Loose binding makes it easier, and cheaper, for corrections to be made, if required, and candidates are strongly advised to submit their thesis loosely bound, in the first instance.

You are encouraged to use a typesetting package (such as LaTeX) for producing your thesis.